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MORPHOLOGICAL CHANGES IN A LARGE SUNSPOT GROUP BEFORE A SOLAR FLARE DURING AUGUST 1972

Translated by CM Bigger from an article by ZB Korobova
Edited by MP Bleiweiss

23 June 1977

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) This document investigates morphological changes in sunspot groups during solar flares. Using photoheliograms taken previously, the investigators traced the fast changes in the morphology of the main sunspot umbrae for the flare active group No. 223. A comparison of the photoheliograms divided into intervals of a few hours showed that although the overall area of the sunspot was extremely stable, the contours of the umbrae and their configurations were changing noticeably.			
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MORPHOLOGICAL CHANGES IN A LARGE SUNSPOT GROUP
BEFORE A SOLAR FLARE DURING AUGUST 1972

ZB Korobova

Solar Data (Solnečnye Dannye) May 1974, p 92-95, Published by the
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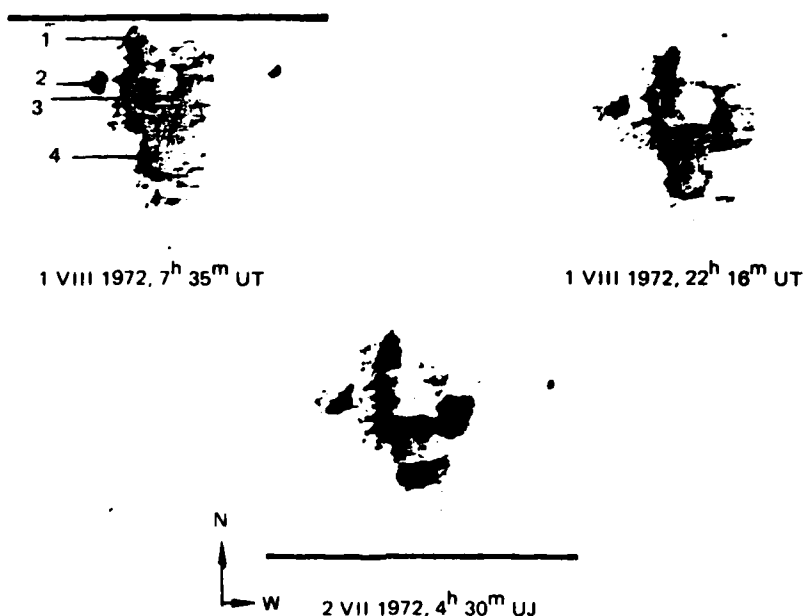
The question of morphological changes in sunspot groups during solar flares has been examined by many investigators.¹⁻³ It has been established through photoheliograms taken before and after a flare that it is possible to detect material changes in the configuration and area of the main sunspots as well as the appearance and disappearance of satellite spots.

Having at our disposal photoheliograms taken in Tashkent, Kislovodsk, and Ussurijsk during the period from 1 through 8 August, we decided to trace the fast changes in the morphology of the main sunspot umbrae for the flare active group No 223* having δ -configuration.

A comparison of photoheliograms divided into intervals of a few hours showed that although the overall area of the sunspot was extremely stable, the contours of the umbrae and their configurations were changing noticeably.⁴

Among the deformations having a gradual evolutionary character, our attention was attracted to one case of abrupt changes which took place in a region of S-spot polarity and which preceded a series of powerful flares on August 2, 1972. The first of these was registered at 3^h 16^m UT and had a range of 1N - 2N.⁵ Before August 2 flares exceeding 1N had not been observed in the group.

The photoheliogram prints are presented in Ill. 1. The first of these was taken 24 hours before the flare which began at 3^h 16^m, the second was made 5 hours before it began, and the third close to its maximum intensity. The diameter of the sun's image on the prints equaled 50 cm. The umbrae of S-polarity (those which were leading in the given hemisphere) have been enumerated.

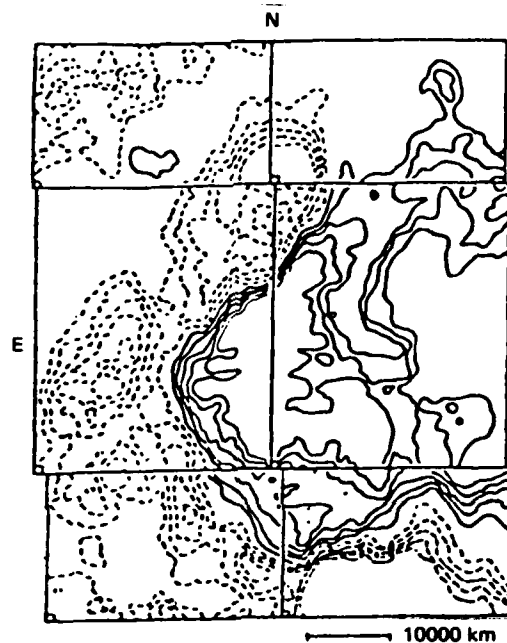


Ill. 1. From ZB Korobova's article (ref 4)

* Enumerated according to the Solar Data Bulletin.

1. SI Gopasjuk i dr, *Izv KrAO*, 29, 15, 1963
2. MJ Martres et al, *IAU Symp* N 35, 318, 1968
3. R Michard, *IAU Symp* N43, 359, 1971
4. ZB Korobova, *Soln dannye*, No 4, 1974
5. Report UAG-28, Part 1, 19, 1973

As the prints show, a few hours before the flare (see the photoheliogram taken on 1 August 22^h 16^m UT) umbra #3 disappeared, having separated prior to this from the large N-umbra by means of a thin penumbral bridge. The remainder of the S-umbra contracted in size, while the area of umbra #4, counted at 7^h 35^m as 44 m.s.h., diminished in size to 23 m.s.h. The deformation of this umbra is of the greatest interest. The umbra assumed an oval form in place of its circular form at 7^h 35^m. When comparing the print taken at 22^h 16^m with the longitudinal magnetic field map for August 2 (borrowed from ref 6, and presented in Ill. 2), it becomes obvious that contraction of umbra #4 occurred in a direction perpendicular to the position of line $H_{||} = 0$, separating this umbra from the umbra of n-polarity. Umbra #1 and #2 were also stretched slightly along the line that divided the polarities, but this contraction is masked by perspective shortening. A narrow appendage which skirted line $H_{||} = 0$ appeared by umbra #1.



Ill. 2. (ref 6)

All of these morphological changes undoubtedly testify that the flare on August 2, which was followed by a whole series of flares in the range of 2 and 3 (among them four proton flares), was preceded by tangential movements in the photosphere, umbral deformation, and a pressing of the umbrae toward the neutral polarity line.

In the N-field region material changes did not occur in the umbral form or area. Here the most noticeable changes were in the fibrous structure of the penumbra of the northern portion of the spot. For the analysis of these changes, more frequent prints are needed.

At the moment when the 3rd photoheliogram was received (between two successive flare maximums⁵), the sizes of the umbrae were reestablished (see lower table) and umbra #4 again assumed a circular form.

6. Report UAG-28, Part 1, 97, 1973

DATE	TIME UT	$\Sigma S_{\tau S}$	$\Sigma S_{\tau N}$	F_S	F_N	$F_N - F_S$	$F_N + F_S$	k (%)
IVIII 1972	7 ^h 35 ^m	97.0	152.8	2457	3901	1444	6358	23
1	22 16	55.5	149.1	1569	4579	3010	6148	49
2	4 38	90.3	153.5	2575	4721	2146	7296	29

The table contains values for the total area of the umbrae of differing polarity and for the magnetic fluxes of the corresponding umbrae.

For the measurement of umbral area, photoheliograms were projected on the screen of a coordinate-measuring device UIM-23* having 12 power magnification, and a transparent millimetre graph-network was then superimposed upon the image. The error limits for the determination of the area did not exceed 10%. The area is expressed in m.s.h. The magnetic flux values for the sunspots are calculated according to the formula $F = FS_{\tau}$, where H is taken from reference 7.

The table shows that for a few hours before the flare the excess of flux with n-polarity over s-polarity doubled. AB Severnyj has repeatedly noticed an increased difference in magnetic fluxes in an active region prior to a flare.⁸ This occurred before the August 2 flare due to an abrupt diminution and contraction of the sunspot's S-umbra.

The values of the coefficient $K = \frac{F_n - F_s}{F_n + F_s}$ are presented in the last column of the table

as a quantitative characteristic "imbalance" of the fluxes as proposed² and again as in reference 2 the onset of the flare was preceded by an increase in K.

In conclusion, the author expresses his deep gratitude to VI Makarov and VF Čistjakov for the photoheliograms submitted.

* Translator's note: Universal measuring microscope

7. Magnitnye polja solnečnyx pjaten Priloženie K bjull "Soln dannye", No 8, 1972

8. AM Zvereva, AB Severnyj, Izv KRAO, 41-42, 97, 1970

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3. R Michard, IAU Symp N 43, 359, 1971
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